

Building a Scale Model of the solar system

Problem: Many students find it difficult to understand the scale of our universe. Today, you will investigate the dimensions of our solar system.

Research:

Mercury is the planet nearest the sun. Neptune is about 80 times as far away. Other small minor bodies called dwarf planets, such as Pluto, Charon and Sedna, orbit the sun hundreds of times farther than Mercury. To measure these distances in the solar system, astronomers use the **astronomical unit (A.U.)**. One A.U. equals the distance between the Earth and the sun. This is approximately 150 million kilometers (92 million miles).

The planets range in size from Mercury to the gas giant Jupiter. The volume of Jupiter is about 200,000 times that of the dwarf planet Pluto and 25,000 times that of Mercury, the smallest inner planet.

Since the distances between the planets are so much greater than their diameters, it is necessary to use two different scales when plotting planets on a single diagram.

Objective:

Using planet data and scale conversions you will construct diagrams that show the relative sizes of planets. A scale model of distance between planets will be plotted on ~~a strip~~ *String* of ~~cash register paper~~.

Materials:

Metric ruler and meter stick

~~Cash register paper roll~~ *String*

Paper

Scissors

Tape/glue

Drawing compass

Procedure A: Comparing Size of Planets

1. Complete the data table below.
 - a. Use a scale of $1\text{mm} = 700\text{ km}$ (This means that for every 700 real kilometers, you will use 1 mm.)
 - b. Round all of your answers to the nearest *tenths place* (0.1).
 - c. Convert the scale diameters from millimeters to centimeters.

Data Table 1: Size Comparisons of Planets

Planet	Diameter (km)	Scale Diameter (mm)	Scale Diameter (cm)
Mercury	4,880		
Venus	12,104		
Earth	12, 756		
Mars	6,787		
Jupiter	142,800		
Saturn	120,000		
Uranus	51,800		
Neptune	49,500		

2. Draw a circle that represents each planet. Use the scale diameters. Use a compass to draw the larger planets. If a planet is too small to use the compass, then you will need to draw it free-hand. Measure the diameters carefully.
3. Save the circles for procedure B.

Conclusion Questions for Procedure A:

1. What are the two largest planets?
2. Which planet is the closest to the size of Earth?
3. How do the sizes of the inner planets compare to the outer planets?
4. How many times bigger is Jupiter's diameter than the Earth's?
5. The Sun has a diameter of 1,394,000 km. Using the scale used in Procedure A, how big would the Sun be in millimeters? _____ cm = _____

Procedure B: Relative Distances Between the Planets

1. Complete Data Table 2 using a scale of 1 cm = 10,000,000 km.
2. Convert all answers greater than 100 cm to meters.

3. Data Table 1: Size Comparisons of Planets

Planet	Distance from Sun (km)	Scale Distance (cm)	Scale Distance (m)
Mercury	57,900,000		
Venus	108,200,000		
Earth	149,600,000		
Mars	227,900,000		
Jupiter	778,300,000		
Saturn	1,427,000,000		
Uranus	2,869,000,000		
Neptune	4,496,000,000		

4. Measure 6 meters of ~~cash register tape/paper~~ ^{String}. At one end, list the names of all students in your group. Draw a line across the tape near one end and label it "Sun". Measure all planet distances from this line.
5. After measuring the distance of each planet and labeling them, attach the planets you cut out in Procedure A.
6. Answer conclusion questions 5-10.

Conclusion Questions for Procedure B:

6. How do the distances between the inner planets compare to the outer planets?
7. Which two planets are closest to Earth?
8. How far away would Neptune be if you used the scale from Procedure A? ($1\text{ mm} = 700\text{ km}$)
9. The star closest to our sun is Alpha Centauri. It is 4.3 light years (41,000,000,000,000 km) away from Earth. Using the scale from Procedure B ($1\text{ mm} = 10,000,000\text{ km}$), calculate the distance it is from Earth.
10. The Large Magellanic Cloud is a galaxy near our Milky Way galaxy. It is 160,000 light-years from Earth. Using the scale from procedure B, calculate how far away it is from Earth.
(Note: $160,000\text{ light years} = 1.5 \times 10^{18}\text{ km}$)